Wrapped up in Tyvek
by James Khamsi

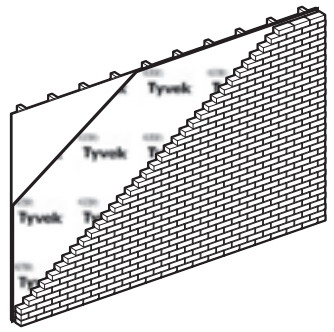
Wrapping Homes

At least three contemporary building codes mandate the use of a water-resistant barrier, or house wrap, in wall assemblies. The Building Officials and Code Administrators International (BOCA) Code (1998) requires house wrap behind stucco, brick, stone, and other porous veneers. In this code, wrapping generally refers to tar-impregnated felt paper. Similarly, the International Residential Code (IRC) mandates that a layer of number 15 asphalt felt be installed outside of the house's stud structure (the water-shedding number 15 asphalt felt dates from the 19th century). In both cases, "other approved water-resistive barriers" are permissible if they meet performance criteria. The International Energy Conservation Code (IECC) specifically mandates the installation of a vapour-permeable barrier.[1] (Vapour-permeable barriers protect from bulk water and, through their specific materiality, manage the flow of air, vapours, and particulate matter. They condition how a house breathes.) The IECC, created in 1989 and since adopted in 41 states, "contains energy efficiency criteria for new residential and commercial buildings and additions to existing buildings. It covers the building's ceilings, walls, and floors/foundations; and the mechanical, lighting, and power systems."[2]

These codes serve different purposes, which explains their differing requirements for house wrap. The IRC and BOCA primarily address structural concerns in construction, and house wraps are specified to protect a building's primary structure from the degradation caused by exposure to the elements. The IECC addresses environmental conditions by establishing standards for environments within a building, as well as responsibilities that buildings have toward the environments in which they are situated.

The ascendency of house wraps indicates a shift in our image of the house, moving from an assemblage of bricks and mortar toward an environment delineated by membranes and foams; this shift has also brought with it new kinds of risk. These three building codes legally define a house as an interior, air-conditioned environment that, as Peter Sloterdijk summarizes, "consists in disconnecting a defined volume of space from the surrounding air."[3] As with all human environments, this conditioned interior must maintain "ecologically dependent vital functions: respiration, central nervous regulations, and sustainable temperature and radiant conditions."[4] This distinction produces differential conditions of temperature and humidity inside and out, which in turn produce condensation, mould growth and air quality issues that can affect the constitution of a house and its inhabitants. Building codes address these concerns by specifying materials with mandated behavioral and performance criteria; placing limitations on the amount of energy that can be consumed to maintain the interior environment; and recognizing that a barrier acts in concert with other materials and has responsibilities towards their protection.

Suits and Wraps



Tyvek Applications: Building weatherization (left), protective garments (right).

Developed in the 1950s and introduced to the market in the 1970s, Tyvek was the first synthetic vapour-permeable barrier, or "homewrap," and currently holds 70% of the market, having displaced felt papers in lightweight frame construction and building codes.[5] Tyvek is an element in lightweight building envelope construction. In a typical wall section, it is on the exterior side of the envelope's framing and insulation, inside its sheathing. Based on its performance, it has been likened to a windbreaker, but Tyvek is actually more like a building's boxer shorts. During construction, Tyvek is visible for a short period of time before it is covered—Tyvek gets its fifteen minutes of fame.

Its application is not limited to homewrap. Understanding these other applications will clarify how it performs and how it has redefined the idea of "house." Tyvek and its associated materials have been tailored into a range of lab coats, coveralls and Level A and B protective suits.[6] In the wake of catastrophic events, television cameras relay images of anonymous technicians, garbed in bright Tyvek overalls, goggles, and boots cleaning up disaster sites, although these images have also become familiar tropes in disaster and dystopian cinema.[7] These suits protect against dirt, dry agricultural pesticides, asbestos, dry chemicals, radioactive dust, lead particulates, and other toxic dust.[8]

Tyvek slows the passage of vapours. Its felted structure allows for the passage of clean air, allowing its occupants' bodies to breath, but snags other particles in its fibers, slowing their progress toward the skin. Tyvek manages risks, but just as a homewrap does not promise to keep all water out of the house, these protective suits do not completely eradicate the possibility of exposure. They can, however, protect against certain contingencies by slowing the progress of airborne particles to a considerable degree.[9] For a suit to completely block off the passage of dangerous particulate matter it would have to hermetically seal its occupant from the passage of all air, which would create the highly uncomfortable situation of slow suffocation. Tyvek suits offer a balance between protection and functionality by elongating the window of time before dangerous levels of exposure are reached—its performance criteria are not absolute rules, but relations of probability.

Material as Infrastructure

Since Tyvek is thin and light, it has no inherent rigidity and must be tacked to other materials to assume its place within an assembly. Unlike sheet metal or wood veneer, Tyvek isn't a thin iteration of a material that we know by its more common and substantive form. And unlike a sheet of paper that can be made rigid through creasing, Tyvek's particularly lithe ductility resists any kind of folding; it is formless.

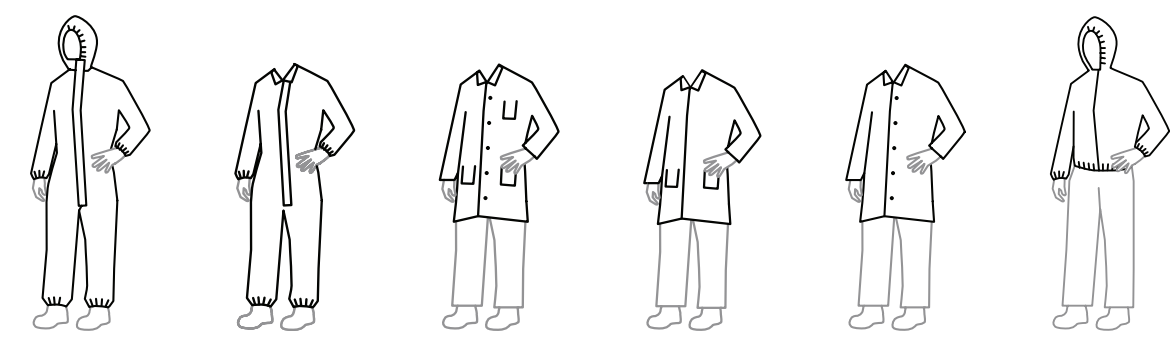
Lacking in structural, insulating, and aesthetic properties, it nevertheless takes its place among other materials in a wall assemblage. Tyvek didn't emerge to play a singular performative role; rather it came to fulfill a need that arose when the construction of building envelopes became foliated into a series of layers. Building systems such as platform framing and rainscreens have moved the industry away from monolithic or homogenous construction techniques.[10] In current practice, framing and sheathing materials provide structure, rigid or batt insulations provide thermal insulation, and siding, panels and veneers (on the outside, with gypsum board typically on the inside) are the visible face of the assembly. These heterogeneous layers are laminated together into a functional envelope. This material sub-specialization has brought speed and lightness to building, and with it a new relationship between construction and the market, with each layer being produced and developed independently by corporations. As these materials drifted into separate corporate spheres, new interfacing problems arose on the building site when the delaminating of envelopes into discrete layers created new fissures and voids where dampness could penetrate and mould grow. These are the concerns Tyvek addresses.

Tyvek shields a building's structure from water, while allowing humidity and moisture trapped in wall cavities to escape. Its performance is neither subject to taste, nor is it a political agent. It demands our trust because its production is so complex. It protects us from vapours at a molecular level invisible to human eyes—regardless of whether they belong to architect, engineer, or contractor. It fails due to micro lesions and capillary effects that can't be monitored, and its failure cannot be predicted; they can only be diagnosed.

Tyvek does not fit into any of architecture's traditional material categories. It is neither ornament nor structure; as a "non-woven material," it has no place in Gottfried Semper's four elements of architecture. Because it is un-categorized, or perhaps because it is unseen, it remains absent from disciplinary discourse and theoretical speculation.

This condition of invisibility, coupled with the fundamental ways it relates us to our environment, allow us to liken Tyvek to infrastructure. Transportation infrastructure, such as freeways or subways, establishes the extent of our accessible environment as well as our mobility within it. Tyvek establishes the thermal and atmospheric conditions of our interiors. Urban infrastructures, "those utilitarian functions which merely support the economic productivity of the community," and Tyvek both belong to the realm of technological and engineering determinism.[11] They are conditioned by criteria of performance and efficiency. They are buried and buffered out of vision and away from aesthetic, social, and political discourses.

Molecular Risk



Classic TYV CHF5S WH 00 | Industry TYV CCF5S WH 00 | Labcoat TYV PL30S WH 00 | Labcoat TYV PL30S WH 09 | Labcoat TYV PL30S WH NP | Jacket TYV PP33S WH 00

And yet, this is precisely where architecture needs to directly confront its material make-up. Conversations on aesthetics and performance are not adequate; materials beckon greater ecological and political scrutiny. Tyvek reveals how materials act in multiple territories of production. When assembled into a construction, heterogeneous materials interact, thus multiplying or offsetting their performances, effects, and risks. By looking at architecture from a materials-first perspective, one can reveal the ways in which works of architecture are simultaneously implicated in multiple ecologies of concern.

According to the product literature, Tyvek is a "protective material" made of "original non-woven technology."[12] On a tactile level, it resembles paper or linen, but is neither; it is, in fact, "spunbonded Olefin." Before it grew into its various roles as a material to wrap houses, a vessel to carry mail, and a textile for protective suits, Tyvek was born as a technology. According to DuPont, it was developed in 1955 when a researcher saw the potential in the "fluff" coming out of a "pipe in a DuPont experimental lab."[13] The product literature implies that the material is not natural—it is a "technology." It is from a lab, the result of propriety knowledge and production that belongs to a corporation, DuPont. But obscured by stories of Tyvek's immaculate conception within a technical ecology of research, innovation, and patenting is the fact that all materials in one manner or another need to be extracted from the earth.

Tyvek is made of long fibers of high-density polyethelene (HDPE). These fibers are polymers, a chemical discovery of the 20th century. Polymers, a rare occurrence in nature, are produced synthetically. HDPE is a polymer of ethylene produced by the petrochemical industry by steam cracking ethane or propane (a process that involves heating natural gas to very high temperatures then rapidly quenching it).[14] Here is where the contradictions of Tyvek begin to accumulate. For example, for an energy efficient building, LEED standards state that "building tight" with home wraps such as Tyvek—with their ability to control the passage of moisture and air—are an essential component to reach these goals. Yet Tyvek immediately implicates a given building in all the risks and liabilities of the petrochemical industry and the oil-based economy.

Tyvek is not alone among building materials in having a complex relationship to risk. In fact one could speculate, as Bruno Latour has, that this is a general property of all materials and objects. In *The Politics of Nature*, he contrasts two genres of object: the smooth object and the tangled object. The smooth object is produced "by strict laws of causality, profitability, and truth" that reflect outmoded sensibilities.[15] We can recognize Tyvek as a smooth object even more clearly when Latour advances that "the researchers, engineers, entrepreneurs, and technicians who conceived and produced these objects and brought them to market became invisible."[16] By contrast, the tangled object does not share the clear boundaries, essences, and clear delineations from its environment as the smooth object; instead, it is implicated in multiple ecologies of risk. It has impacts and consequences on environments and processes that are difficult to conceive. For Latour, these two genres of object do not currently co-exist. Rather, the smooth object reflects a traditional (i.e. modernist) attitude, which has given way to a more tangled point of view. Latour illustrates his point with the example of asbestos, "one of the last objects that can be called modernist," demonstrating how it was conceived from within a technological milieu full of promise, though over time it was revealed to be tangled in multiple catastrophic and carcinogenic risks.[17]

Tyvek, a plastic polymer and a product of the 1960s, shares some of the initial promise and "smoothness" of asbestos; it renders a home impermeable and resistant to its environment. It promises a smooth object. To be sure, Tyvek has not yet borne any of the health risks of asbestos, but it does carry its own risks. Asbestos failed *in situ* with its end-users by causing harm to individuals who came in contact with it. In *Risk vs. Risk*, John D. Graham and Jonathan Baert Weiner advance the concept of the risk tradeoff—the paradox that "some of the most well-intentioned efforts to reduce identified risks can turn out to increase other risks."[18] To understand this phenomenon they introduce two specific genres of risk: target and countervailing. Countervailing risks are unintended exposures that arise from the mitigation of a target risk.[19] Materials are implicated in risk (target or countervailing) at two moments: their formation and their application. In its application, Tyvek's target is to reduce the risk of damage to person and property caused by exposure to harmful environmental elements. On this point, DuPont's product literature highlights end-user benefits—energy efficient homes, lower bills, etc.—but rarely, if ever, does it address countervailing risks. These risks emerge at the material's formation, which, in the case of Tyvek, is obscure. By tracing the material's elements back through their reformation at Dupont, their polymerization, their refinement to their extraction from the earth, their roots in the petrochemical industry emerge, and we can begin to understand the countervailing risks for a society completely wrapped up in Tyvek. Thinking of Tyvek as a process allows us to see how two contradictory registers of concern—both target and countervailing risks—enter contemporary architecture practice through the same material. Tyvek is not alone in this regard; contemporary practitioners are repeatedly faced with such contradictions. To reveal them we cannot continue analyzing architectural objects—buildings—as wholes. Despite critical ambitions, the whole remains inscrutable; it is only when examining sub-systems, component parts and constitutive materials that we glimpse a more complete picture of our contemporary materiality and its ethical entanglements.

Notes

1. Paul Fisette, "Housewraps, Felt Paper and Weather Penetration Barriers." Building and Construction Technology program in the Department of Environmental Conservation in the College of Natural Sciences, bct.eco.umass.edu/publications/by-title/housewraps-felt-paper-and-weather-penetration-barriers
2. See the IECC website: resourcecenter.pnl.gov/cocoon/morf/ResourceCenter/article/161
3. Peter Sloterdijk, *Terror from the Air* (New York: Semiotext(e), 2009), 20. For a more complete elaboration of his spatial philosophy, see Peter Sloterdijk, *Bubbles* (Los Angeles: Semiotext(e), 2011).
4. Ibid., 16.
5. "Homewrap" is a term that has come to denote Tyvek and its competitors. The term itself is indicative of the limitations of the product. It is not a full weather barrier, and the literature on the product takes care to avoid creating that expectation. See also, "Making sense of Housewraps," *Fine Homebuilding*, February/March 2006, 66.
6. Tychem is a related product that uses Tyvek by DuPont.
7. See, among others, *Outbreak*, *Contagion*, *Breaking Bad*, *Back to the Future*, *The X-Files*, *The Andromeda Strain*, and *12 Monkeys*.
8. For product specifications for DuPont TY212S WH lab coat made of Tyvek, see safespec.dupont.com/safespec/productDetail.action;jsessionid=9CA0699A6E3DD9FD1EC7C10C80ADA0F8.tomcat1?prodId=138
9. See: www2.dupont.com/Tyvek_Different_Protection/en_GB/tyvek-story/index.html
10. In other forms of wall construction, a single material will perform several of these tasks at once. A monolithic masonry wall will provide all three functions with one material. A curtain wall, a modern and lightweight assembly technique, will use glass and metal (steel or aluminum) frames to provide structure, aesthetics, and insulation (although as a system it is not a great insulator).
11. William Morrish and Catherine Brown, "Infrastructure for the New Social Compact," in eds. Douglas Kelbough and Kit Krankel McCullough, *Writing Urbanism: A Design Reader* (London: Routledge, 2008), 138.
12. See www2.dupont.com/Tyvek/en_US/index.html
13. See www2.dupont.com/Tyvek/en_US/products/about_pgs/history.html; see also "DuPont(TM) Tyvek(R) Marks 40 Years of Energy Efficiency and Protection; Innovative Applications Help Protect Buildings, People, Products and Critical Documents," *PR Newswire*, www.prnewswire.com/news-releases/duponttm-tyvekr-marks-40-years-of-energy-efficiency-and-protection-58160667.html.
14. James G. Seight, *The Chemistry and Technology of Petrolium* (New York, Basel: Marcel Dekker Inc, 1999.), 503.
15. Bruno Latour, *The Politics of Nature* (Cambridge: Harvard University Press, 2004), 22.
16. Ibid.
17. Ibid., 23.
18. John D. Graham and Jonathan Baert Wiener, "Confronting Risk Tradeoffs," in eds. Graham and Weiner, *Risk Versus Risk* (Cambridge: Harvard University Press, 1991), 1.
19. Ibid., 2.

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